



# Dual Output Driver

## Description

The CS3706 integrated circuit provides an interface between low-level TTL inputs and high-power switching devices such as power MOSFETs. A typical application is single-ended PWM control to push-pull power control conversion.

The primary function of this device is to convert a bipolar single-ended low current digital input to a pair of totem pole outputs which can

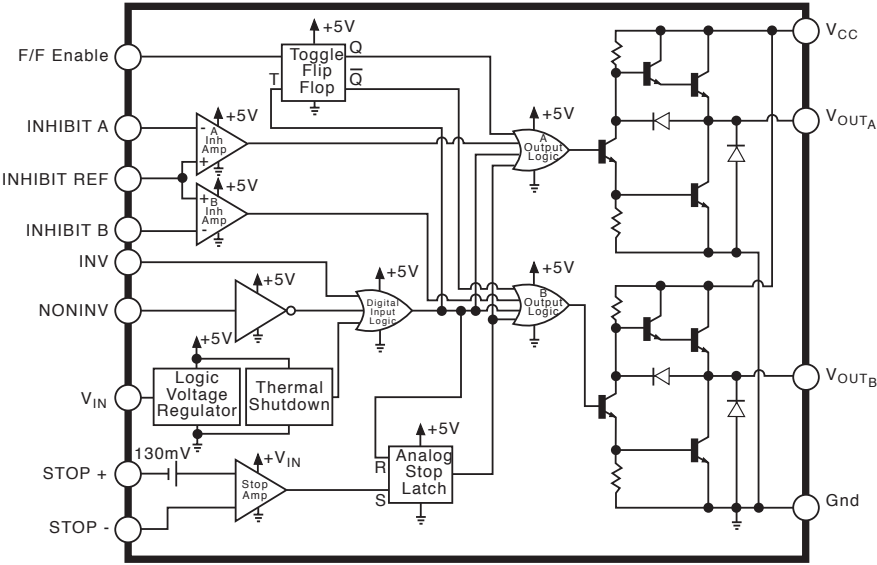
source or sink up to 1.5A. An internal flip-flop, driven by double-pulse suppression logic, can be enabled to provide single-ended to push-pull conversion. With the flip-flop disabled, the outputs work in parallel for 3.0A capability.

Protection functions are also included for pulse-by-pulse current limiting, automatic deadband control and thermal shutdown.

## Features

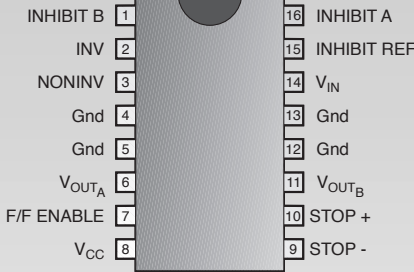
- Dual 1.5A Totem Pole Outputs
- 40nsec Rise and Fall into 1000pF
- Parallel or Push-Pull Operation
- Single-Ended to Push-Pull Conversion
- High-Speed Power MOSFET Compatible
- Low Cross-Conduction Current Spike
- Analog Latched Shutdown
- Internal Deadband Inhibit Circuit
- Low Quiescent Current
- 5V to 40V Operation
- Thermal Shutdown Protection

## Block Diagram



## Package Options

16 Lead PDIP  
(Internally Fused Leads)



Note: All Four Ground Pins must be Connected to Common Ground.



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### Absolute Maximum Ratings

|   |                         |
|---|-------------------------|
| Logic Supply Voltage ( $V_{IN}$ ) .....                 | 40.0V                   |
| Output Supply Voltage ( $V_{CC}$ ) .....                | 40.0V                   |
| Output Current (each output, source, or sink)           |                         |
| Steady State .....                                      | ±500mA                  |
| Peak Transient for Less Than 100 $\mu$ s .....          | ±1.5A                   |
| Capacitive Discharge Energy .....                       | 20.0 $\mu$ J            |
| Digital Inputs (INV, NONINV) .....                      | 5.5V                    |
| Analog Inputs (STOP +, STOP -) .....                    | $V_{IN}$                |
| Inhibit Inputs (INHIBIT A, INHIBIT B, INHIBIT REF)..... | 5.5V                    |
| Operating Temperature Range .....                       | 0 to 70°C               |
| Storage Temperature Range.....                          | -65 to 150°C            |
| Lead Temperature Soldering                              |                         |
| Wave Solder (through hole styles only).....             | 10 sec. max, 260°C peak |

Notes: All voltages are with respect to the four ground pins which must be connected together. All currents are positive into, negative out of the specified terminal.

### Electrical Characteristics: These specifications apply over the operating temperature range of the IC. ( $V_{IN} = V_{CC} = 20V$ , Pins 4, 5, 12 & 13 = 0V; unless otherwise stated.)

| PARAMETER                       | TEST CONDITIONS  | MIN | TYP  | MAX  | UNIT    |
|---------------------------------|--|-----|------|------|---------|
| $V_{IN}$ Supply Current         | $V_{IN} = 40V$ , $V_{CC} = 20V$ , INV = 0V,<br>Unused pins = open. |     | 8    | 12   | mA      |
| $V_{CC}$ Supply Current         | $V_{IN} = 20V$ , $V_{CC} = 40V$ , Outputs low                      |     | 3    | 5    | mA      |
| $V_{CC}$ Leakage Current        | $V_{IN} = 0V$ , $V_{CC} = 40V$                                     |     | 0.05 | 0.10 | mA      |
| Digital Input Low Level         |  |     |      | 0.8  | V       |
| Digital Input High Level        |  | 2.2 |      |      | V       |
| Digital Input Current           | $V_I = 0V$   |     | -0.6 | -1.0 | mA      |
| Digital Input Leakage           | $V_I = 5V$   |     | 0.05 | 0.10 | mA      |
| Output High Sat., $V_C-V_{OUT}$ | $I_{OUT} = -50mA$  |     |      | 2.0  | V       |
| Output High Sat., $V_C-V_{OUT}$ | $I_{OUT} = -500mA$   |     |      | 2.5  | V       |
| Output Low Sat., $V_{OUT}$      | $I_{OUT} = 50mA$   |     |      | 0.4  | V       |
| Output Low Sat., $V_{OUT}$      | $I_{OUT} = 500mA$  |     |      | 2.5  | V       |
| Inhibit Threshold               | $V_{REF} = 0.5V$   | 0.4 |      | 0.6  | V       |
| Inhibit Threshold               | $V_{REF} = 3.5V$   | 3.3 |      | 3.7  | V       |
| Inhibit Input Current           | $V_{REF} = 0V$   |     | -10  | -20  | $\mu$ A |
| Analog Threshold                | $V_{CM} = 0V$ to 15 V  | 100 | 130  | 150  | mV      |
| Analog Input Bias Current       | $V_I = 0V$ , $V_{CM} = 15V$  |     | -10  | -20  | $\mu$ A |
| Thermal Shutdown                | Turn on  |     | 155  |      | °C      |
| Thermal Shutdown                | Turn off   |     | 125  |      | °C      |

**Typical Switching Characteristics: ( $V_{IN} = V_{CC} = 20V$ ,  $T_A = 25^\circ C$ . Delays measured 50% in to 50% out.)**

| PARAMETER                  | TEST CONDITIONS                                 | OUTPUT $C_L =$ |     |     | UNIT |
|----------------------------|---|----------------|-----|-----|------|
| From Inv. Input to Output: |   | open           | 1.0 | 2.2 | nF   |
| Rise Time Delay            |   | 110            | 130 | 140 | ns   |
| 10% to 90% Rise            |   | 20             | 40  | 60  | ns   |
| Fall Time Delay            |   | 80             | 90  | 110 | ns   |
| 90% to 10% Fall            |   | 25             | 30  | 50  | ns   |
| From N.I. Input to Output: |   |                |     |     |      |
| Rise Time Delay            |   | 120            | 130 | 140 | ns   |
| 10% to 90% Rise            |   | 20             | 40  | 60  | ns   |
| Fall Time Delay            |   | 100            | 120 | 130 | ns   |
| 90% to 10% Fall            |   | 25             | 30  | 50  | ns   |
| $V_C$ Cross-Conduction     | Output Rise                                     | 25             |     |     | ns   |
| Current Spike Duration     | Output Fall                                     | 0              |     |     | ns   |
| Inhibit Delay              | Inhibit Ref. = 1V<br>Inhibit = 0.5 to 1.5V      | 250            |     |     | ns   |
| Analog Shutdown Delay      | Stop (+) Ref. = 0<br>Stop (-) Input = 0 to 0.5V | 180            |     |     | ns   |

**Package Pin Description**

| PACKAGE PIN #                   | PIN SYMBOL   | FUNCTION  |
|---------------------------------|--------------|---|
| <b>16L PDIP</b>                 |              |   |
| <i>(Internally Fused Leads)</i> |              |   |
| 1                               | INHIBIT B    | Control pin for deadband control on Channel B.  |
| 2                               | INV          | Inverting input for output drivers.   |
| 3                               | NONINV       | Noninverting input for output drivers.  |
| 4                               | Gnd          | Ground.   |
| 5                               | Gnd          | Ground.   |
| 6                               | $V_{OUT(A)}$ | Channel A output.   |
| 7                               | F/F ENABLE   | Controls the phase of the two outputs.<br>F/F ENABLE = Gnd Out of phase.<br>F/F ENABLE = floating In phase. |
| 8                               | $V_{CC}$     | Supply voltage (5V to 40V) for output drivers.  |
| 9                               | STOP -       | Inverting input for stop latch comparator.  |
| 10                              | STOP +       | Noninverting input for stop latch comparator.   |
| 11                              | $V_{OUT(B)}$ | Channel B output.   |
| 12                              | Gnd          | Ground.   |
| 13                              | Gnd          | Ground.   |
| 14                              | $V_{IN}$     | Supply voltage (5V to 40V) for IC (except output driver).   |
| 15                              | INHIBIT REF  | Reference input for deadband control.   |
| 16                              | INHIBIT A    | Control pin for deadband control on channel A.  |

### Outputs

The totem-pole outputs have been designed to minimize cross-conduction current spikes while maximizing fast, high-current rise and fall times. Current limiting can be done externally either at the outputs or at the common  $V_{CC}$  pin. The output diodes included have slow recovery and should be shunted with high-speed external diodes when driving high-frequency inductive loads.

### Flip/Flop

Grounding F/F Enable activates the internal flip-flop to alternate the two outputs. With pin open, the two outputs operate simultaneously and can be paralleled for higher current operation. Since the flip-flop is triggered by the digital input, an off-time of at least 200nsec. must be provided to allow the flip/flop to change states. Note that the circuit logic is configured such that the "OFF" state is defined as the outputs low.

### Digital Inputs

With both an inverting and non-inverting input available, either active-high or active-low signals may be accepted. These are true TTL compatible inputs—the threshold is approximately 1.2V with no hysteresis; and external pull-up resistors are not required.

### Inhibit Circuit

Although it may have other uses, this circuit is included to eliminate the need for deadband control when driving relatively slow bipolar power transistors. A diode from each inhibit input to the opposite power switch collector will keep one output from turning on until the other has turned-off. The threshold is determined by the voltage on INHIBIT REF which can be set from 0.5 to 3.5 V. When this circuit is not used, ground INHIBIT REF and leave INHIBIT A&B open.

### Analog Shutdown

This circuit is included to get a latched shutdown as close to the outputs as possible, from a time standpoint. With an internal 130mV threshold, this comparator has a common-mode range from ground to ( $V_{IN} - 3V$ ). When not used, both inputs should be grounded. The time required for this circuit to latch is inversely proportional to the amount of overdrive but reaches a minimum of 180nsec. As with the flip-flop, an input off-time of at least 200nsec is required to reset the latch between pulses.

### Supply Voltage

With an internal 5V regulator, this circuit is optimized for use with a 7 to 40V supply, however, with some slight response time degradation, it can also be driven from 5V. When  $V_{IN}$  is low, the entire circuit is disabled and no current is drawn from  $V_{CC}$ . When combined with a CS384X PWM, the Driver Bias switch can be used to supply  $V_{IN}$  to the CS3706.  $V_{IN}$  switching should be fast as undefined operation of the outputs may occur with  $V_{IN}$  less than 5V.

### Thermal Considerations

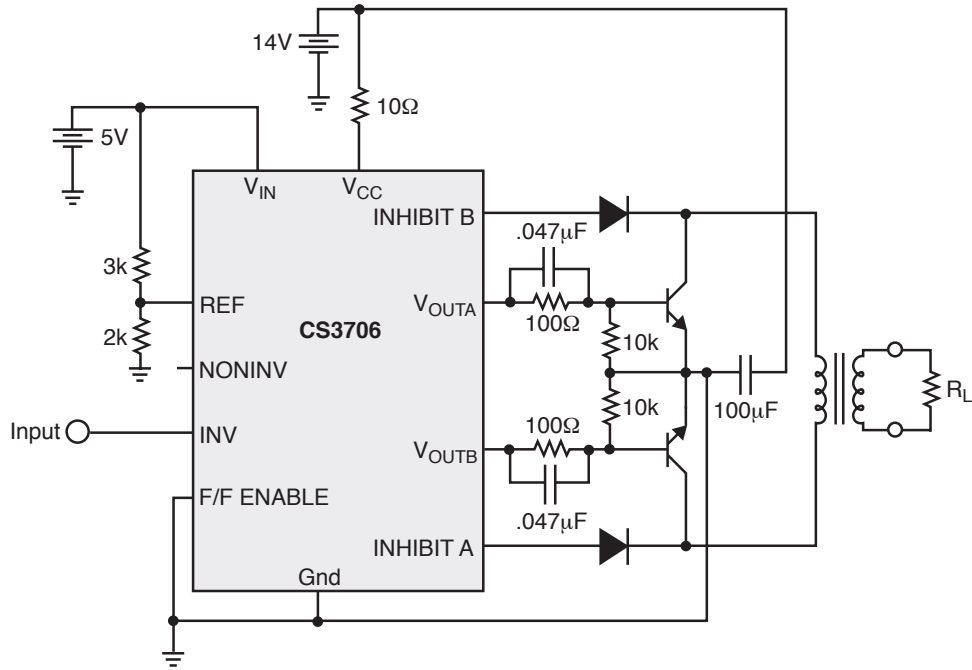
Should the chip temperature reach approximately 155°C, a parallel, non-inverting input is activated driving both outputs to the low state.

Truth Table

| INV. | N.I. | OUT |
|------|------|-----|
| H    | H    | L   |
| L    | H    | H   |
| H    | L    | L   |
| L    | L    | L   |

$\overline{OUT} = \overline{INV}$  and N.I.

$\overline{OUT} = INV$  or N.I.



## Package Specification

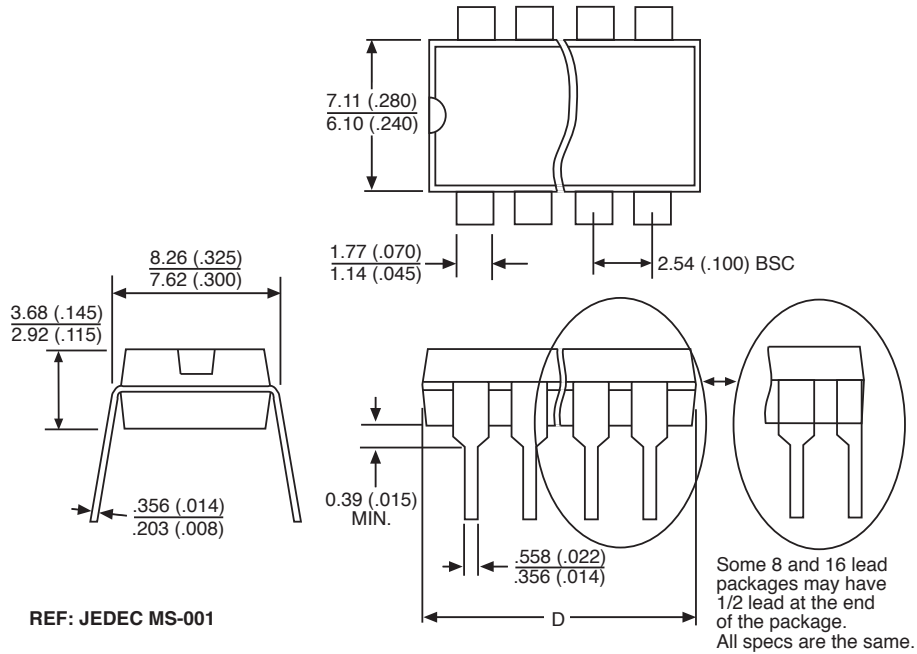
### PACKAGE DIMENSIONS IN mm (INCHES)

| Lead Count                           | D      |       |         |      |
|--------------------------------------|--------|-------|---------|------|
|                                      | Metric |       | English |      |
|                                      | Max    | Min   | Max     | Min  |
| 16L PDIP<br>(Internally Fused Leads) | 19.69  | 18.67 | .775    | .735 |

### PACKAGE THERMAL DATA

| Thermal Data    |     | 16 Lead PDIP<br>(Internally Fused Leads) |                             |
|-----------------|-----|--|-----------------------------|
| $R_{\theta JC}$ | typ | 15                                       | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | typ | 50                                       | $^{\circ}\text{C}/\text{W}$ |

### Plastic DIP (N); 300 mil wide



### Ordering Information

| Part Number | Description                              |
|-------------|--|
| CS3706GNF16 | 16 Lead PDIP<br>(Internally Fused Leads) |

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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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